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EDITORIAL

JANUARY, 1930

The New Year will open with many of our branches holding their annual meetings during this month and February, March and April, and it is hoped that papers read and discussions on same will be preserved and forwarded to "Editor" of your monthly REVIEW that all the members of the A. E. S. may enjoy them and profit by them.

The cost is nominal to a branch that is budgeting an annual meeting to obtain a shorthand reporter and will keep intact many very valuable discussions that are now being lost.

Within the membership rolls of our society are many famous educators, who, at these affairs, speak informaly on questions of wide importance to the industry, which if tabulated would be a valuable reference for the future.

Remember that the greatest pleasure an A. E. S. member can get is to be of service to his associates. So let us endeavor to make history by preserving this valuable information lost in the past.

DO NOT FAIL TO GET YOUR FEBRUARY, 1930, REVIEW AND READ, WARNING TO INDUSTRY, BY MR. PHILLIPS OF DETROIT BRANCH.

INDUSTRIAL CLEANING OF METAL

Dr. A. K. Graham

In view of the fact that I told Mr. Jamison along about February that I would try to prepare something for the convention, I gave a subject upon which I hoped to talk, and then after I got ready to actually get my thoughts together, I realized the subject was rather a large one and that I probably couldn't satisfy you as far as filling the bill is concerned. So that you will pardon me if in speaking tonight I don't cover the subject as broadly as the title might lead you to believe I should.

The removal of lubricants, compositions, metallic oxides and passive films from metal surfaces is common to the manufacture of all metal products. Whether it be a final cleaning prior to packing and shipping or a treatment preparatory to a subsequent manufacturing operation, the methods employed may be quite varied. The selection of any one will depend upon the metal to be treated, the substance or substances to be removed, and the object of the cleaning. An intelligent choice of a method requires an intimate knowledge of the chemistry of both the metals and substances involved, and in addition, an understanding not only of the usual cleaning operations employed but also of any subsequent manufacturing operation.

It is not possible, in the brief time available, to discuss all the possible methods of treating the numerous industrial cleaning problems. However, the fact that the foreman plater is being consulted in connection with many problems not directly associated with plating, and that even in plating the simple caustic scrub and acid dip of the past no longer suffices to produce work of the quality now demanded, makes it imperative that the plater know as much as possible about both the problems of cleaning and the methods of handling them. Furthermore, with the rapid introduction of automatic machines for handling all sorts of work, it is necessary that the cycle of operations be correctly determined before the machine is built. It is also desirable that the plant executive or engineer have sufficient understanding of what is involved to appreciate the value of the increasing number of operations in the automatic cleaning cycle and to recognize when the additional expense so entailed is justified. A brief outline of some problems

of cleaning, and then a critical discussion of the basic operations common to most of these problems may therefore be of value.

Industrial cleaning may be classified according to the object of the cleaning in the following manner:

1. Grease removal only,
2. Cleaning preparatory to painting or enameling.
3. Cleaning preparatory to hot dipping.
4. Oxide scale removal only.
5. Cleaning preparatory to dip finish or chemical coloring.
6. Cleaning preparatory to plating.

1

Where one is concerned with the removal of grease alone, the metal being treated and the nature of the grease, whether saponifiable or not, are the governing factors. In general, two solutions are used—a soaking solution and an alkali cleaned, or an old and fresh alkali cleaner. If the metal is attacked by ordinary cleaners, milder alkalies, weaker concentrations, or even organic solvents may be used.

2

In removing oxide scale resulting from an annealing operation the problem is not merely one of choosing the proper pickle or dip for the metal being treated. Copper or its alloys containing some organic matter upon the surface, if improperly annealed may exhibit red spots of cuprous oxide which are not removed in the customary sulphuric acid pickle and if a weak dichromate pickle is used the surface is usually badly etched before the red spots are removed. Steel, on the other hand, if improperly heat treated or annealed, will frequently exhibit an uneven scale which upon pickling will show areas covered with a very adherent film of so-called carbon. It is quite similar to the film caused by over-pickling, and while commonly mistaken for the same will not respond to changes in the pickling conditions. The fact remains that many difficult pickling problems may be simplified by modifying the conditions under which the scale is produced.

3

In preparing metal for painting or enameling, complete removal of grease and oxides is essential, necessitating both alkali cleaning and either pickling or sand blasting.

There is considerable difference of opinion as to the best method of removing the oxide prior to enameling. Some favor sand

blasting; others the use of an acid pickle, and yet both methods are in successful use. It would seem that if the acid pickling is thoroughly understood that it is equal if not superior to sand blasting. The former is certainly more attractive when the installation cost, the floor space and the operating conditions are considered. Furthermore, in sand blasting heavily scaled areas, there is a tendency to drive the oxide into the surface rather than to completely remove it. On the other hand, in pickling, the tendency is to etch the surface slightly, prior to enameling, thus insuring better adherence. Under these conditions, there is little likelihood of any oxide remaining. One would therefore conclude that only in the case of cast iron, where it is impossible to pickle without entrapping acid in the pores of the metal, is sand blasting admittedly superior.

In certain cases, where the size of the parts and the presence of "beading" make it impractical to immerse in solutions, as with automobile bodies, sand blasting is not permissible because of the expense and the time and floor space involved. In such cases clay compounds containing grease solvents and acid have been successfully introduced. The compound is sprayed upon the metal, dried at 180° F. and can then be brushed off, leaving a clean oxide free surface.

4

In hot dipping, complete oxide removal is essential. In most cases there is not sufficient oil upon the surface to interfere with pickling so that cleaning is not necessary. Etching of the surface in this case is not detrimental but advantageous.

5

In order to produce a satisfactory dip finish or a uniform chemical coloring upon a metal surface, it must be free from both grease and oxide and quite uniform in lustre. The cleaning and pickling must therefore be carefully done in order to preserve the finish.

It sometimes happens that the buffing wheel becomes loaded with finely divided metal which has a tendency to pack in designed or recessed parts of work, and which will not be removed by the ordinary soaking and cleaning methods. The material to be removed is metal and not buffing composition, and requires mechanical treatment.

6

The preparation of a metal surface for a plated finish requires

more care than any of the previous cases. The preparatory cleaning is also more of a problem because of the numerous factors involved and frequently it is of greater importance than the plating itself. One is not only obliged to remove a variety of lubricants and compositions in the soaking and alkali cleaning solutions, but in addition to completely remove all traces of oxide and any films either resulting from pickling, from inhibitors or from passive metal. While the lustre must not be impaired by overpickling, yet the surface should be etched to a sufficient degree to insure bonding of the deposit, and in the end the results to be expected from careful attention to all of the above details may be entirely lost by failure to neutralize the acid or alkali upon the work prior to introducing into the plating bath; and this latter point deserves much more serious consideration.

Having thus outlined a variety of the cleaning problems about which the plater is frequently concerned, it may be well to briefly discuss the following important operations common to most of them:

1. Soaking solutions.
2. Electric cleaners.
3. Pickling solutions.
4. Bonding solutions.

1

Organic solvents or soap compounds should be used as soaking solutions wherever the quantity and nature of the oil or buffing composition to be removed justify it. By their use the subsequent electric cleaning operation can be shortened, the control of the solution is better, and the cleaning is much more effective. In automatic plating machines, a soaking solution insures satisfactory performance with rather wide variation in the condition of the work as it comes to the cleaner.

Since organic solvents present a real fire hazard they can not readily be incorporated in a machine. Their use is confined to die castings and similar metals which cannot be given a long soap soak and drastic alkali cleaning.

2

Hot alkaline cleaners are most always operated with the electric current, particularly in automatic machines where the improved cleaning thereby attained is most essential in the absence of any brushing or swabbing. The work is most always made

the cathode. This causes less passivity than were it made the anode, but any dissolved metals or colloids in the cleaner may under certain conditions be deposited upon the work. A short reverse electric cleaning is therefore commonly introduced to assist in removing this film or stain. This must be a separate solution, as otherwise the metal dissolving would accumulate and be redeposited as a metal film while the direct current is being applied.

While many concerns are manufacturing cleaners, yet there is much to be learned concerning the proper composition and conditions of operation of an electric cleaner. Not all the staining occurring in electric cleaning is due to dissolved metals. It is known that the current density has a marked effect upon the results obtained. It is also possible that the phosphate present in so many cleaners is responsible for some of the staining on steel. The black Parkerized finish obtained with phosphate is well known. Furthermore, while it is true that finely divided solid particles in suspension assist cleaning, yet the clays used for the purpose contain alumina which is sufficiently soluble in the caustic present to form a soluble aluminate or colloidal hydroxide. This can be electrically deposited upon the work, causing serious roughness. It is believed that research will give much valuable information and marked improvement in this phase of cleaning as well as in the development of methods of control.

Sulphuric acid, hydrochloric acid, or a mixture of the two, are used in pickling steel. Sometimes a nitric acid dip is used in addition to the above.

It should be remembered that nitric acid is essentially an oxidizing acid and as such does not dissolve iron directly. It is most generally used where organic matter on the surface has prevented the pickle from acting. In such cases it will destroy the organic matter and a subsequent immersion in the improper cleaning prior to pickling. It is not to be recommended, however, since it is impossible to control the activity of the dip as the temperature and concentration changes, and serious etching of the surface usually results. It also leaves the steel passive, making it quite difficult to plate.

Both sulphuric and hydrochloric acid will produce equally good results, provided equivalent acid strengths are used, but the former is usually preferred because it is not as volatile and therefore is

less corrosive. There is no apparent advantage in using a mixture of the two. In fact, it complicates the chemical control and the mixture must be handled similarly to hydrochloric acid, i. e., in rubber lined tanks or stoneware.

The activity of a pickle will vary with the concentration of acid, and the temperature. In the case of an electrolytic pickle, the current density and whether the work is made anode or cathode will also have a marked effect. It is beyond the scope of this paper to discuss these variables in detail, but the time required to produce a given result will depend upon all of them. While a certain amount of experimental work must always be done in determining the best conditions for any one job, a great deal of fundamental research remains to be done to define the optimum condition for electrolytic pickling.

Satisfactory control methods have been worked out for pickling solutions resulting in uniform performance and economy. Further economy is effected by the intelligent use of a so-called "pickle control" or inhibitor. The chief advantage attending its use is:

Less attack of the oxide free surface.

Less acid consumption.

Less acid fumes.

Care must be exercised in choosing an inhibitor if it is to be used prior to plating as some will deposit difficulty removable films upon the surface of the metal. Furthermore, in electrolytic pickling there is danger of explosion from the evolved gases being held in the blanketing foam. While the use of inhibitors in this connection offers marked advantages, here again there remains much to be learned.

Bonding solutions have been shown to be very necessary in producing an adherent nickel deposit upon aluminum. It has long been the practice of silver platers to pass nickel silver through a weak bright dip in order to bond the deposit sufficiently to permit burnishing without lifting. It is customary to bright dip copper and its alloys in preparation for plating. This treatment not only insures a bright, oxide free surface, but also etches the surface so that the bonding effected is undoubtedly an important factor in the adherence of the deposit. On the other hand, polished brass, which is not ordinarily given sufficient acid treatment to etch it, will not exhibit the adherent deposit that can otherwise be obtained if a definite etching or bonding operation is introduced. It

is believed that one very real advantage of a pickle for steel is the bonding resulting. In general, therefore, more attention should be devoted to this treatment.

In the problems that have been presented and the discussion that has been offered, an attempt has been made to sort fact from fiction and to point out where our knowledge is most meager. Having done so, it is hoped that the ensuing discussion and subsequent research will supply the need.

(Applause.)

CHAIRMAN KENNEDY: Is there any discussion on Dr. Graham's paper?

MR. WINEMAN (Chicago): I would like to ask Dr. Graham if he has done any work particularly with an A. C. pickle, using alternating current.

DR. GRAHAM: I have never done work with A. C. pickling. As a matter of fact, electrolytic pickling usually brings up the question whether we are going to put the work in as cathode or anode. The objection to putting it in as an anode is that at the anode oxygen will be evolved and you will have a tendency to make the metal passive. If sulphuric acid is used with hydrochloric acid, that won't exist, but you would have a severe attack nevertheless. If you make the work the cathode, then the possibility of passivity can be disregarded, and we have the evolution of hydrogen upon the surface.

Now there has been very little real work done, or at least published, on electrolytic pickling, but it is my belief that the advantage of making the work the cathode is that the hydrogen which is evolved is undoubtedly evolved in an atomic condition and is therefore quite energetic as a reducing material. It will reduce oxide from the pores of the metal, and having once reduced it, the sponge metal which is left will dissolve much more in the acid. I believe that is the advantage of cathode pickling.

Now as to the use of alternating current, we know for a fact that you have over a definite period of time neither anodic nor cathodic action; you have a reversal. And I am not prepared to say whether it is an advantage or not.

MR. J. HAY: I would like to ask Dr. Graham on the words that he mentioned about polished brass, in regard to adhesion of deposition of metal. I didn't quite catch that.

DR. GRAHAM: If I understand the question, you didn't under-

stand what I said regarding polished brass. I merely stated that in the ordinary treatment where you have polished brass, you do not give a severe acid treatment such as will permit you to bright dip it. Consequently, the polished surface is not given much of an etching in the ordinary cleaning treatment that is given to it, and because of that there is a possibility of the bonding being much poorer than where it is given some sort of treatment as a bonding operation to give it such etching, so that it will probably be more adherent.

MR. MAXWELL KESSLER: I would like to ask Dr. Graham if by etching he means visible etching or an etching such as a cyanide bath might cause.

DR. GRAHAM: I would say that the etching is sometimes visible, but not sufficiently so to destroy the finish.

MR. KESSLER: If you give it a chromic acid dip, the surface is still bright; but apparently it is etched because the final deposit will adhere very closely. The effect of chromic acid is a pickling effect. It must have the etching effect even though you can't see it.

DR. GRAHAM: It is well known that you can bright dip brass with a bichromate solution.

MR. F. J. HANLON: In the special bright solutions recommended for brass and so forth, isn't it possible that sometimes those have a tendency to be construed as pits under the final deposit?

DR. GRAHAM: Are you referring to bright dips for brass?

MR. HANLON: Yes. The bite, or the cleansing operation.

DR. GRAHAM: Ordinarily if you take a piece of brass which was given the customary dip, and then the final bright dip, it gives the eye at a distance a very bright, smooth finish. On the other hand, if you examine it closely, it is quite etched.

MR. CORBIT: I understand there is a process for cleaning buffed brass with bright dip. Is that correct?

DR. GRAHAM: Brass can be bright dipped in sulphuric acid solution containing potassium bichromate.

MR. CORBIT: Doesn't that have a tendency to give a crystal finish on a brass surface when buffed?

DR. GRAHAM: When buffed, yes; but that particular dip is not used on buffed or polished brass; it is used to give a brightening effect on brass.

MR. CORBIT: I thought I understood a previous speaker to say they have cleaned buffed brass with a bichromate solution. That, I couldn't understand.

DR. GRAHAM: I didn't understand it that way, either.

SECRETARY GEHLING (to Mr. Kessler): Did you mean to say that you had cleaned buffed brass, that is, a polished or buffed brass?

MR. CORBIT: With bichromate of potash and didn't destroy the finish?

MR. KESSLER: No, it is part of the cleaning operation, after the alkali has been cleaned, dipped in chromic acid.

SECRETARY GEHLING: It is not polished, though.

DR. GRAHAM: Chromic acid will etch it; there is no question about that.

CHAIRMAN KENNEDY: If there are no further questions, and if there is no further discussion on Dr. Graham's paper, I am going to ask Mr. Hogaboom to step forward and take care of the Question box.

MECHANICS OF CHROMIUM PLATING

Walter W. Rowe

In presenting this paper, I wish it understood that I am speaking strictly from experience gained during the past three years by practical application. I do not claim to know much about the art, but I am learning something new every day. My employers were the pioneers in chromium plating electrical table appliances. They have spared no expense in experiments and equipment, and today have a very modern plating outfit. I have them to thank for all the practical knowledge I have gained, and I also wish to give the plater on my chromium tanks a proper share of credit for our success.

In order to speak intelligently on my subject, I must touch on several different factors that enter into the successful deposition of chromium. Therefore, I will endeavor to classify, and speak briefly on each step as I go along. In writing an article, or talking on this subject, there are so many different essential factors to think about, that probably some very important ones which should be mentioned will be left out.

The first, and I believe the most important step in chromium

plating, is the successful deposition of nickel, especially on such work as I am doing. (Percolators, table ware, etc.) which are composed of different metals, have Britannia metal trimmings, and are all soft soldered. In nickel plating, one of the most important steps is proper cleaning the article to be plated. This is an operation that has not had proper attention in the past. Cleaners are a source of trouble that platers are apt to overlook until they commence to find some spoiled work, when they then have to get busy and find the source of the trouble. I know that personally, I never used to study my cleaning problems as much as I ought, until we commenced to plate chromium over nickel. I have learned a lot about cleaners since, by experience, and now, we watch our cleaning solutions just as closely as we do our plating baths, and today we have no peeled work due to that source. The nickel solution must have good throwing power and we must get a good soft adherent deposit, otherwise in chromium plating the nickel will peel, especially around soldered seams. The nickel solution must be kept clean, either by filtering or some other method. We should use pure nickel anodes, the chlorine content of the bath should be high enough for proper anode corrosion. The other factors that govern a good soft nickel deposit are temperature, current density, and control of acidity.

In the next step in chromium plating, I have found the buffing of the nickel deposit has a whole lot to do with the finish. I have learned that you can not nickel color an article too good for chromium plate, as every scratch and blemish is magnified after it comes out of the bath. Greasy finger marks, streaks from the buff, and gray dirty buffing, all cause a gray chromium deposit. I have also learned that lime buffing composition can be burned into the work, especially into nickel plated steel goods which hold the heat from buffing longer, causing a gray smoky deposit. This can be proven by taking some work which is causing trouble and re-coloring it on a soft buff. You will find it will then come out of the chromium bath all right, provided the nickel deposit is not cut through. I have found that, in most cases, when goods are poorly nickel buffed but the deposit is good otherwise, you can get good results by running them through a strong electric cleaner and pickle, and the chromium deposit will come out bright. In my experience at the present time, the principal cause of bad work is not in the chromium plating, but in the fact that the nickel is sometimes cut through causing it to take a gray chromium deposit, or

else no deposit at all, due to the fact that the solution has attacked the base metal. When I find this condition, I strip off the chromium deposit in hot HCL, re-color it, strike for five minutes in a bright nickel solution, rinse and put directly into chromium bath. Sometimes a spot can be doctored by sponging with chromium solution but this usually not very satisfactory and takes about as long as stripping and refinishing. Most of our work is chromium plated without running through the cleaning cycle. We simply wipe the nickel off with a soft cloth. Then place in the bath at a low current for a few seconds (bath acts as a cleaner); next raise to necessary voltage for required length of time. The reason I do not run all my work through the cleaners is because if the nickel is cut through, cleaning and pickling will cause deposit to show gray, especially on white metal.

The next stop, and one of the greatest problems in chromium plating is the proper racking of the work. We must study our work to decide what kind of racks that will give the required protection on high spots, and heavy enough to carry the load without heating, but still not so large as to use up too much current. By making an intelligent study of the job, and trying to plate it at different angles in the bath, sometimes a lot of shading can be eliminated. On some of our work that required a lot of shading, we can now plate bottom side up without any shading, by simply making the work holder conform to the shape of that part of the work, thereby giving the necessary protection. I keep all my shading at least one inch away from any work, and wherever possible I use fine wire for that purpose where needed on my racks which does not obstruct the flow of current. For plating inside of dish or bowl shaped article, I use a work rack with a lead wire anode connected on to it by porcelain insulators. The anode wire is covered with glass tubing where it passes close to the work. The bare end of this wire is placed in depression wherever needed. The upper end of this anode wire is insulated and has a spring clip for attaching to the anode bar on the plating tank. With this device, I have very little trouble throwing into deep difficult places, and very little shading is required. All my shade rings, etc., are lacquered wherever possible with a hight resistance lacquer. I find that by lacquering all these devices, I use much less current and get better throwing power. For instance, we do not want any chromium plate inside of a percolator, or a sugar bowl or cream pitcher, and these are heavily gold or silver lined.

Therefore, we make a ring to fit inside the top of the article, coat it with lacquer and get a good bright plate clear to the very edge. This lacquer lasts for quite a long time if kept out of the strong alkali cleaners, and is very easy to renew by simply burning off the old coating and applying a new coat. All my work racks are made of copper with the contact hooks made in such a way that there is enough spring in them to fit tightly on the cathode bars.

For anodes I use 6 per cent Antimony Lead, 3 inches wide. They are of various lengths according to the work I am doing. I find that when I am running tanks steadily, they do not coat over to any extent. My reason for using narrow anodes it the fact that most current flows from the edges and the bottom of the anode through the solution, and if you need a larger surface, it is very easy to put in extra anodes. I use an anode surface of about 3 to 1, and place them so as to conform to the shape of the work. I made them of different lengths. I have a long one to reach below the bottom of the job and shorter ones to throw into a depression higher up. Anode connections must be tight. I use copper hooks soldered on with enough spring in to make them fit tightly. I find that steel anodes offer too much resistance to the current, and besides, the solution will build up gradually in iron content, which I believe must be controlled. I find, too, that products form on steel anodes that are detrimental to the deposition of chromium.

In our next step (the deposition of chromium) the plater finds several different factors to consider. The first is to have a well balanced solution. No matter what strength solution he is using, the H_2SO_4 content must be kept at the right ratio in proportion to the CrO_3 content. He must keep absolute control of his solution at all times. Personally, I believe in analyzing for all constituents. I analize weekly for H_2SO_4 and CrO_3 and occasionally for Fe and Cu and Cr_2O_3. I can tell by the action of the solution when it is about to turn over, and I oxidize it back by raising the temperature, and current density of the solution and plating an old anode for about one half hour and then cooling it down to normal temperature. Once a month I clean out any sludge or chromates that may be in the bottom of the tanks (and work that may be lost in the tank must be taken out immediately; otherwise the solution will build up in the metals and cause a lot of trouble). When oxidizing the solution back from the trioxide to the

sesquioxide state, you will first notice a black scum rising to the top of the solution; next a yellow froth appears. When this scum disappears and the froth turns into a steady bubbling action, the current. I have found that the usual cause of plating solution current density, etc. Keep all HCL away from your plating solutions and plated work, as HCL fumes attack deposit and gets into rinse water causing milky color and spot on work. It also attacks chromium on the plating racks, causing particles to fall off into solution. Use H_2SO_4 for pickle, as it is much cheaper and just as good. I believe in keeping an accurate record of all my plating solutions. Therefore, I keep a graphic chart of each solution which shows at all times how it stands. The chart shows each addition of H_2SO_4 or CrO_3, and you always have it to refer back for comparison. I find that the deeper the work hangs in solution the better, provided the anode surface is correct. I am plating all small articles strung on fine copper wire with a copper cathode hook reaching down into solution heavy enough to carry the current. I have found that the usual cause of plating solution turning over is too small an anode surface, provided the CrO_3 content is correct. I find by keeping the SO_4 content down as low as possible, I get better throwing power. Also, the higher the temperature possible to use, the better the throwing power, the less shading required, and the brighter the deposit. If sulphate is too low, you get poor throwing power, but can produce good work by raising the temperature. If work comes out gray, temperature is too high, or connections may be loose, or current may be too high. If too high in sulphate, run cold at higher amperage to bring SO_4 content down. Burnt work is usually caused by too large an anode surface, provided CrO_3 content is correct. Work then requires more shading. If work does not plate at all, temperature is too low, or not enough anode surface, or bath is too high in sulphate. When temperature is too low, solution attacks brass or nickel silver and gives it an etched effect. Too low sulphate concentration causes brownish film to appear on work, but no deposit. You can still run solution by raising the temperature about 30 or 40 per cent of CrO_3, content is correct. If suphate content becomes too high in relation to CrO_3, you still can get good deposit by lowering temperature. High SO_4 content causes blackish, cloudy work burnt on high spots. You can plate by running at low temperature. Do not use $BaCO_3$ to neutralize H_2SO_4, because while $BaCO_3$ in the presence of H_2SO_4 is sup-

posed to form insoluble $BaSO_4$ such is not entirely the case; some of it goes back into a soluble sulphate form causing no end of trouble. It is better to get rid of excess spulphate by running solution cold at high amperate. (Plate a dead man, any old heavy work, or an old anode.)

In conclusion I will state that any well balanced solution will give good results when you have become familiar with it, but the plater must keep studying all the time for better production methods, and keep trying different ways of holding his work to eliminate as much as possible, racking and shading. In every new job, there is a new problem to overcome, which is easy when it is mastered. The plater must be enthusiastic and not easily discouraged, and sooner or later success will crown his efforts.

CHAIRMAN VAN DERAU: I want to again emphasize the things Mr. Hogaboom said about Mr. Rowe, and the things he has accomplished in overcoming some very great difficulties in chromium plating of hollow ware. I was in Mr. Rowe's place last February, and it is well worth anybody's time to visit that plant and see how he has met a number of these problems, as noted in the paper. I feel sure if Mr. Rowe was here a great many of us would have some questions to ask him. Inasmuch as he is not here, we will pass over that part.

MR. HOGABOOM: Mr. President, there is one word Mr. Rowe uses that I would like to explain, because it may not be understood. I have never heard anyone use it in the way that he has, and probably some of you may be the same as I found myself. The word "shading."

I am not an artist, but I will try and show you two of the things that Mr. Rowe does, which I personally think is important. If he has a body to plate, that has a spout on it, and has a socket projecting, and as he says in his paper, he doesn't want to plate the inside, he will make his holder so that it has a heavy band inside the neck, there, a ring, and that ring is what he coats with lacquer, so that no current can come down inside of the pot. So he gets a perfect deposit down to where this heavy band is on the inside. (Draws on blackboard.)

Where he has a spout, he forms a little cage, just made of little wires, put around the spout, and a piece going down inside of the spout. He keeps those wires from one to two inches

away from that spout. That permits him to use high current density so as to get in those hollow places, without burning the edge of the spout. He also puts these little wire cages on the side for the sockets.

Now if he has an urn that has no spout, but has a botton, then he takes a piece of very fine lead wire around this part (drawing) and connects that up with his anode rod. He doesn't attempt to get a large anode area, but just something to seemingly attract the current, and that is sufficient to get throwing power.

Now if he has a piece that has a large body like that (draws vase with long narrow neck, large body), he will plate it with a long anode and a short one, like this (draws).

He has made these little cages to be sort of shock absorbers to take the brunt of the current when using high current density to get good throwing power.

MR. PHILIP UHL: How does he protect the spout from contact?

MR. HOGABOOM: He doesn't protect it from contact; it is just to protect it from the high current, just little thin wires so he can get the high current without burning the work, the edge of the spout. I don't know of any man in the industry that has made a closer study of the mechanics of chromium plating than Mr. Rowe, and I am sorry he isn't here.

QUESTION BOX

Conducted by Geo. B. Hogaboom at Detroit Convention

MR. GEORGE HOGABOOM: One of the questions about which I spoke a few minutes ago—a question was asked if the salt spray test is not standard, or we can not get dependable results, why have it adopted, and why not make a change so as to obtain a good test for electro-deposits. It has been found, as I stated, that a great many factors enter into the manner in which the salt spray test is used, and the size of the drops that are atomized, and the air in the box materially affects the rate of corrosion. That is one of the things, no doubt, that the Bureau of Standards will study, through the Research Committee.

Another question was asked. In Mr. Turnock's talk, he seemed

to emphasize the point that current density and time were the most important things, or upon those you could base deposits. Was that correct?

There are other things that influence character of deposits equally as much as time and current density. Efficiency, cathode efficiency. You may get in some cases a very low cathode efficiency. For example, we know that in a double nickel salt solution containing no chloride, that the highest efficiency you may get would be about 15 per cent, whereas it is possible to obtain well over 95 per cent cathode efficiency. It is well known, also, that where there is heavy evolution of gases, that cathode efficiency is materially changed, and that would be important in considering both time and current density. If you were depositing copper on electrotype shells, you would not be interested in the character of the deposit. In electro-plating, where the character of the deposit is of prime importance, then, those things must be considered, and you must know, if you wish to obtain good deposits, the kind of base metal, its physical characteristics, its surface conditions, and the rates at which the deposition is carried on, and whether you will get a crystal structure that will be dense so as to afford the best protection or afford a finish that will receive a high luster. We have seen bumper bars, for example, that have been plated at very high current density. It may be an economical manner in which to plate bumper bars at the factory, but compare them with those that are plated at a lower current density for luster or for beauty of finish and you will note those that are plated at the higher current density look far more gray, and do not have the high luster of those at the lower current density.

There was another question asked, about enamelling cadmium deposits. In speaking with one of the large manufacturers of enamels, he told me that so far they have not been able to develop a satisfactory enamel for cadmium. The question was asked if there is no enamel, what is a good method to produce a black finish upon cadmium. The easiest way, in all probability, would be to electro-plate it with black nickel, and then either oil it or lacquer it.

CHROMIUM PLATING FACTORS

Oliver Sizelove

The introduction of chromium plating into the field of electroplating has given to the plater the necessity of a more careful study of certain factors that control the successful electrodeposition of chromium. It has also taught him that the other solutions that are used in conjunction with chromium plating would have to be controlled more carefully also.

The experimental stage has passed and production is now demanded in practically all lines of work that lend themselves to the finish of chromium.

A few short years ago, very little was known of the different factors that control the successful deposition of chromium and no control methods were used. It did not take long for the plater to realize that there were more factors to be controlled than was the case with some of the other solutions in use, and that they would have to be controlled more definitely.

The work that has been done by the Bureau of Standards at Washington, D. C., under the able direction of Dr. Blum, and also the work done at the University of Michigan at Ann Arbor, under the direction of Dr. Schneidewind, has been of great help in the study of these factors and they deserve a great amount of credit for their work.

For decorative effect, it is desirable to produce a deposit that is bright so as to eliminate subsequent costly and difficult polishing operations. To produce a deposit of this character requires careful control of the several factors, namely, temperature, current density, bath concentration, anode material, also the sulphate and tri valent content of the bath.

Temperature

Temperature variations seem to be over a considerable range, from 100° F. to 130° F., depending upon the current density used. As the temperature is increased, the current density must be increased proportionately. With a temperature of 100° F. to 110° F. and a high chromic acid content better current distribution is obtained, although the efficiency may be lower and the bright plating range is somewhat narrower. On the other hand, a high temperature has a tendency to increase the tri valent chromium content and an increase of this factor decreases the efficiency of the bath.

Cathode Current Density

The cathode current density varies with the temperature, chromic acid, sulphate and tri valent chromium content. If a very low current density is used, there will be no chromium deposited and the current will reduce the chromic acid to tri valent chromium. If the current density is increased until there is a decided evolution of gas at the cathode, chromium will be deposited and upon the amount of current used depends the character of the deposit.

A low current density produces a milky deposit, so will too low a temperature. If the current density is increased too greatly, a matted deposit is obtained. It is, therefore, obvious that as the current density is increased, it is necessary to increase the temperature to produce a bright deposit.

It is also necessary to use a higher current density if the sulphate and tri valent chromium content are high.

Anode Material

The two metals that are usually used are lead and iron. The metal that has the lowest rate of corrosion when solution is in use, would seem to be preferable and this metal is lead. When lead anodes are used, the solution remains in a better condition, because the tri-valent chromium formed during electrolysis is reoxidized to a great extent to chronic acid.

A low sulphate content and a low temperature favors low anode corrosion when iron is used as anodes. The more iron that goes into solution, the greater the resistance the bath has, resulting in poor throwing power. The only point that favors any use of iron as anodes is that they remain clean and this one reason in their favor is not enough to offset the disadvantage.

A 6 per cent antimony lead alloy is being used with good results, no scale being formed. There will be produced a coating of lead chromate but it is soft and easily removed, if necessary.

Some leads when used as anodes have a tendency to scale or become coated with load chromate, but this can be removed by placing them, when not in use, into a saturated solution of sodium chloride, slightly acidified with hydro-chloric acid.

Sulphate Content

It is impossible to produce a deposit of chromium that has any merit from a solution of pure chromic acid dissolved in water. It is necessary to have present in the bath also, a sulphate, and the easiest way to introduce same into the bath, is by the addi-

tion of sulphuric acid, although chromium sulphate or other sulphate salts may be used.

Exactly what part the sulphate ion performs, or what reaction takes place is not thoroughly understood, but we do know that it is a necessary constituent and a very important one.

Too low of a sulphate content causes brown stains to appear on the cathode, while with too great of a sulphate content, the throwing power of the solution is decreased.

It has been found in practice that the best results are obtained when the sulphate concentration, expressed as the ratio by weight of hexavalent chromium to the sulphate ion $\frac{cr\ IV}{SO\ 4} = 50$. Better a slightly lower sulphate content than one that is too high.

The sulphate content remains practically constant after being introduced into the bath, the only possible loss being in the drag-out and the spray caused by the evolution of the gas escaping through the exhaust system.

Large additions of the sulphate are, therefore, not only necessary, but will cause a decrease in the efficiency of the bath.

Chromic Acid Concentration

The chromic acid content varies greatly, from 20 to 67 oz. per gallon being used, but this fact must be kept in mind, that while a solution of lower concentration has a slightly higher efficiency, the throwing power of the bath is also lower. Also, if the concentration of the bath is high and better throwing power is had, the efficiency of the bath is somewhat lower. Solutions that contain less than 20 oz. of chromic acid per gallon should not be used as the bright plating range is narrow and the resistance of the solution is great. Solutions above 55 oz. of chromic acid per gallon are not to be recommended either, as the efficiency is quite low, the bright plating range narrow, and the throwing power poor.

The solution must be replenished by the addition of chromic acid from time to time, for with the use of insoluble anodes, the only source for the metal content is by the addition of chromic acid.

Tri Valent Chromium

There is a certain amount of tri valent chromium in all chromic acid plating solutions due to reduction during electrolysis. When present in large quantities, the throwing power of the bath is de-

creased and brown stains are formed on the cathode. The presence of large quantities of tri valent chromium in the bath is indicated by the color of the solution, the darker the solution the larger the amount present.

The factors that tend to prevent the formation of tri valent chromium are low temperature, low sulphate content, low anode current density, the use of lead anodes and continuous operation of the bath.

Tri valent chromium can be converted to the hexavalent chromium by hanging on cathode rod a porous cup containing a solution of chromic acid and into which is suspended a strip of lead that is connected to the cathode. The bath is worked with a high current density until the tri valent content is reduced.

I believe that it has taken less time for the plater to learn how to chromium plate than it did with some of the other solutions that are in use today.

We have had the assistance of the chemist and electrician in helping to study the different factors that control the successful deposition of chromium and we have profited by the work they have done.

Before chemistry entered the field of electroplating, no control methods were used and practical experience was the only teacher. Today we have better chemical and electrical control of the various solutions than ever before, and all that is required of the plater is work out the methods that are suggested or recommended by the chemist or electrician.

We do not need to be a graduate chemist or electrician to be successful electroplaters, but a general knowledge of chemistry and electricity are valuable assets, and with the opportunities that are available today to study these factors the plater has no one but himself to blame if he does not take heed and devote some of his spare time to the study of the chemical and electrical factors that play such an important part with his work.

PROVIDENCE ATTLEBORO BRANCH

Preparation of Metals for Finishing

Outline by Mr. Wm. F. Cahill of J. B. Ford Co.

The first consideration in studying the finishing of metals is the method by which the lubricating oils or buffing greases are removed from the surface of the articles to be finished.

There are four methods quite distinct, i. e., the washing machine, the oblique tumbling barrel, of wood, iron, or brass; the hot (alkaline) dip in which articles to be cleaned are immersed in a cleaning solution, the temperature of which is maintained at 180° to 212° F. and the last, the electro-cleaning method in which the conditions are practically the same as the hot dip method except that a current is used, generally the tank, which is either iron or steel, is connected so that it serves as the anode, thus making the work the cathode. Each method has its individual advantages. Rapid production is attained by the use of the washing machine on large pieces of work, likewise the tumbling barrel is excellent for small parts which are not easily injured by the rolling action.

The immersion method is still widely used but is rapidly being replaced by the more thorough electro-cleaner (for final cleaning). All of these methods have their proper places in the present day production and none can be entirely replaced by the other. Having ascertained the method by which work is to be cleaned, it is next highly advisable to study the composition of the oil or grease that is on the article to be finished.

Fundamentally, we have two general classifications of oils, those which can be saponified and rinsed from the work as a soap, after being treated with an alkaline bath, and those which can be removed from the work by emulsification, usually the emulsifying agent being an alkaline solution of a somewhat different nature from the saponifying solution.

Then, too, for lubricating compounds, we have mixtures in many different proportions of both kinds of oils. I believe at present there are no less than two hundred and eighty-five mixtures of these two classes of oils on the market.

Under these conditions it can readily be seen that the development of more efficient oils has called for a like development of

more efficient alkaline compounds for removing these oils before the final process of finishing; in other words, the greater the content of saponifyable oil in the lubricating compound the greater should be the percentage of saponifying agent in the cleaner. The same holds true for oils which contain a greater percentage of oil which must be emulsified.

This general rule holds true in a great many cases, but of course exceptions must be made when the metal to be cleaned is readily attacked by the cleaning compound. For that reason a study must also be made of the kind of metal of which the work is composed.

As you already know, hot alkaline solutions slowly attack copper, brass, and lead and rapidly interact with zinc and aluminum even when cold. For this reason special care must be exercised to get a cleaning compound balanced properly with slow-acting ingredients when cleaning nonlferrous metals and their alloys.

I have found that, to my own satisfaction, the best results on non-ferrous metals and their alloys are obtained by the use of a mild cleaning compound in an electro-cleaning tank, with a voltage of six to eight and the temperature maintained about 180° F. This is not true in all cases, for again I must say there are exceptions to the general rule. However, by a little experimenting in some individual cases the solution of the cleaning problem can usually be found.

Acids, too, play a major part in the preparation of metal for finishing, for by their use the oxides on the surface of the metals are removed by chemical reaction followed by thorough rinsing. The most widely used acid I believe is muriatic, since it forms chlorides of the metals and most chlorides of the metals are soluble in water, or at least in an excess of the acid. Sulphuric acid and nitric acids have their places in the industry, and in particular instances, are better than muriatic.

Sodium cyanide is also widely used, especially on brass, since the oxide of copper is readily changed to the double cyanide and soluble in water.

Too much care cannot be taken in rinsing, since either the presence of alkali or acid on metal going into the plating tank, or japan, or lacquer rooms, will increase the number of rejects and decrease the profits of the employer. A few extra dollars spent on water may save hundreds of dollars.

In conclusion then, the points which I wish to emphasize in solving a problem in cleaning metal are: first, choose the most

efficient method; second, know the composition of the oil to be removed; select the proper cleaning compound for your work, know the effect of the different acids and of cyanide on your particular metal and use the ncessary amount of fresh clean water for rinsing.

With this I close, inviting a general discussion.

WILLARD M. SCOTT

August 9, 1895—December 3, 1929

Mr. Scott was born in Wilmington, Del., and received his early education in the High Schools of Wilmington, and later came to Philadelphia and pursued his studies in chemistry at the Temple University.

Mr. Scott was the president of the Willard M. Scott Plating Co., on Hancock street, Philadelphia, and for several years before starting in this business had charge of the Plating Department at the Frankford Arsenal.

He was librarian of the Philadelphia branch for three years during which time the branch selected him as instructor of the Electro-Plating class at the Kensington Evening High School, and which position he still held at the time of his sudden death.

He has also served the branch as delegate to the Milwaukee, Montreal, Newark and Toledo conventions, and will be missed by the friends he made during his short stay in this world.

WILLARD M. SCOTT
August 9, 1895—December 3, 1929

AMERICAN ELECTRO-PLATERS SOCIETY

Secretary-Treasurer's Quarterly Membership and Financial Report for the Second Quarter Ending November 30, 1929

Total Receipts

Per cap. tax from the branches	$810.56	
Supplies to the branches	22.00	
Sale of Convention Reports to the branches	47.79	
Sale of Convention Reports to the members	104.98	
Total receipts	$985.33	$985.33

Total Expenditures

Printing and Mailing "Monthly Review"	$517.68	
Balance due on Convention reports	175.00	
Electros	5.50	
Secretary's office expenses	10.54	
Total expenditures	$708.72	$708.72
Total gain for second quarter		$276.61

Recapitulation for First Half of Fiscal Year

Total cash on hand, June 1, 1929	$2,642.05	
Total receipts for six months	2,015.73	
Total	$4,657.78	
Total expenditures for first six months	2022.00	
Total cash on hand November 30, 1929	$2,635.78	
Total cash on hand June 1, 1929	2,642.05	
Deficit for first six months		$ 6.27

Respectfully submitted, December, 1929,

GEO. GEHLING. Secretary-Treasurer.

	Members Aug. 31, 1929	Elected	Reinstated	Suspended	Resigned	Died	Loss by Transfer	Gain by Transfer	Total Members Nov. 30, 1929	Per Cent	Receipts from Branches: Supplies	Convention Reports	Balance Due from Branches
Balto.-Wash.	35	2	..	..	..	1	..	..	36	17.85	.....	.....	.....
Boston	24	4	..	..	..	..	..	..	28	12.60	4.50	.....	.....
Bridgeport	59	3	..	1	1	..	..	..	60	31.50	.....	.....	.....
Chicago	210	3	..	1	..	..	..	1	213	110.77	.....	.....	.....
Cincinnati	38	..	..	..	..	..	..	..	38	.....	.....	.....	39.90
Cleveland	42	..	..	..	..	..	..	..	42	22.05	.....	.....	.....
Dayton	31	2	..	..	..	..	..	..	33	16.27	3.00	.....	.....
Detroit	73	9	1	1	..	..	..	..	82	78.75	3.00	3.71	.....
Grand Rapids	31	1	..	..	..	..	..	..	32	16.27	.....	.....	.....
Hartford, C. V.	42	1	..	3	..	..	..	..	40	44.62	.....	3.73	.....
Indianapolis	24	..	..	..	..	..	..	..	24	12.60	.....	.....	.....
Los Angeles	46	7	..	..	..	..	..	..	53	27.82	2.50	.....	.....
Milwaukee	56	2	1	..	..	..	..	..	59	30.45	.....	3.76	30.97
Montreal	20	..	..	..	..	..	..	..	20	10.50	.....	11.13	10.50
New York	115	3	..	..	..	..	..	..	118	60.90	.....	.....	.....

Newark	103	10	..	..	..	..	..	..	113	57.75	6.00	.....	.....
Philadelphia	119	2	..	..	..	..	..	..	121	63.00	.....	.....	.....
Pittsburgh	36	4	..	..	..	..	..	..	40	68.32	3.00	3.63	.....
Providence	34	3	..	..	..	..	..	..	37	.....	.....	.....	40.36
Rochester	70	8	..	1	..	..	..	..	77	36.75	.....	3.67	38.32
St. Louis	62	..	..	..	1	..	..	..	61	32.55	.....	.....	.....
Toronto	66	..	..	..	..	..	..	..	66	34.12	.....	.....	.....
Toledo	26	..	..	..	..	..	..	..	26	27.30	.....	14.49	.....
Waterbury	32	..	..	..	..	..	..	..	32	16.80	.....	3.67	16.80
Worcester	21	..	..	..	..	..	..	..	21	11.02	.....	.....	.....
Totals	1415	64	2	7	2	1	0	1	1472	810.56	22.00	47.79	176.85

AMERICAN ELECTRO-PLATERS SOCIETY

Philadelphia, Pa., January 10, 1930.

To the Officers and Delegates of the Supreme Society; also the Presidents and Secretaries of the Branch Societies:

Greetings: With our last quarterly report we sent out a letter promising to send a report and letter to each officer and delegate of the Supreme Society each quarter, so that they may keep in closer touch with the membership and financial progress of the society during their term of office.

Enclosed find the quarterly report for the second quarter, and it will be noted that we had a deficit of $6.27 for the first six months, but had all the branches paid their per capita tax when due we would have had a credit of $170.58 instead of the small deficit.

Constitutions are being mailed to all branch secretaries and we hope branches will see that their newly elected members get copies in the future. This has been sadly neglected in the past, partly through the fault of the Supreme Society, and we hope this can now be corrected.

The following is the Detroit Convention Committee's report to this office on December 12, 1929, and we are printing it in this letter so that all the delegates and branches will be better informed on the question: "should the Supreme Society finance and manage the conventions instead of the branches?" as was proposed at the Detroit convention last summer. No action was taken at that time, due to the fact that no definite plans for such a change had been submitted.

Detroit, Mich, December 12, 1929.

Mr. Geo. Gehling, Secretary-Treasurer, A. E. S.:

The following is the copy of the Detroit Convention Report:

Receipts

Advertising in program	$5,245.00	
Registrations	3,509.00	
Total receipts	$8,754.00	$8,754.00

Expenditures

Printing and mailing program	$1,412.50
Badges and buttons	769.10
Motor busses, theatre party, Belle Isle trip, Bois Blanc trip, and meals	2,707.05
Banquet and music	3,017.55

Donation to Washington Branch, 1930 convention..	150.00	
Research fund	150.00	
Total expenditures	$8,206.20	$8,206.20
Balance		$ 547.80

Chas. M. Phillips, Secretary-Treasurer Convention Com.

At the Montreal convention the Supreme Society's secretary was instructed to advertise and also circularize the coming conventions for a better attendance, and the same has proven a great help to the convention committees by having an increased attendance each year, and since that time the convention committees have appreciated the work of the society by making a substantial donation to help pay for the expenses incurred by the Supreme Society at the conventions, but we are sorry to say that Detroit's committee, this year, overlooked this item.

GEO. GEHLING, Secretary-Treasurer.

ZINC PLATING

Presented at the December Meeting of the A. E. S. Detroit Branch

Two metal coverings are commonly used which protect the under metal, usually steel, by sacrificing themselves. These metals are zinc and cadmium. In order that nickel or copper plating may protect steel from rusting, these metals must make a perfectly tight seal and keep air and water from beneath them. Zinc and cadmium give protection even though they may have minute holes due to their corroding instead of the steel. They corrode because they are chemically more active than steel or iron as seen in the electromotive series. Aluminum could do this, but there is no method of electroplating it from water solution, and some chemists say aluminum will never be plated from a water solution. I understand that aluminum has been electroplated at the University of Illinois from a non-water solution. The solvent used would, of course, be one capable of ionization—that is—capable of carrying electricity.

Zinc is commonly electroplated from sulphate solutions and from cyanide solutions. There is also a chloride solution, and Blum & Hogoboom in their book, "Principles of Electroplating & Electroforming," mention that zinc can be deposited from zincate solutions and acetate solutions.

The sulphate solutions are numerous and many of them work

about equally well. They usually have a rather large zinc sulphate content, two to three pounds per gallon of $ZnSO_4$ 7 H_2O, and often another sulphate to repress the zinc ion content of the solution and increase the conductivity, such as aluminum sulphate, or possibly sodium sulphate. Aluminum sulphate, however, acts to brighten the zinc deposit possibly due to some colloidal action in the solution. Glucose or corn sugar also act as a colloid to give a smoother, denser plate. This colloidal action is not well understood. Glucose, licorice, or very small amount of glue is necessary. Glue should be used with caution. Common salt, and sal ammoniac are often used to increase conductivity. The chloride ion is not necessary for successful plating.

Proper acidity of the solution is necessary, but the limits for open tank work are wide. A slight evolution of hydrogen on the anodes is a fair indication of proper acidity. Boric acid is highly recommended as a buffer to maintain acidity. It can be added as borax and acidulated with sulphuric acid.

For barrel plating the solution must be practically neutral or even very slightly alkaline. I have operated barrel plating solutions with a slight turbidity due to suspended zinc hydrate, and I have seen solutions for barrel plating, which would zinc plate only the high spots and leave the recesses totally bare, give passable work after stirring in a few handfuls of zinc oxide.

The throwing power of a zinc sulphate solution falls considerably short of all that is desired, and often when trying to cover a recessed spot the prominent places become badly roughed, or possibly tree formations appear with extended plating time.

A satisfactory formula can be made as follows:

Zinc Sulphate 7 H_2O	32 oz. per gal.
Aluminum Sulphate	4 oz. per gal.
Ammonium Chloride	2 oz. per gal.
Glucose	12 oz. per gal.

For barrel plating, these quantities should be increased 25 to 50%.

Sulphate zinc plating requires a well cleaned surface for plating. Most of the troubles experienced with zinc sulphate solutions are due to poorly cleaned surfaces. A slight film of grease or acid black is fatal to good work.

Zinc anodes may be of ordinary commercial grades of zinc, but the higher purity anodes are freer from the accumulation of dirty oxides which foul the anodes and increase their surface resistance,

and also contaminate the solution with tiny specks of suspended material which lodge on the work and make it rough. This is argument enough for the best zinc anodes. One-half to three-quarters per cent of mercury in the anodes will prevent all but a small part of this dirt forming, and the greatest portion of it will settle to the bottom of the tank.

A current density of 30 amperes per square foot of cathode at 6-7 volts has been used on a production line. 100° F. to 110° F. are the most favorable plating temperatures.

With cyanide, the cleaning may be poor, and yet a fair job be obtained, because the evolution of hydrogen in the alkaline solution will remove much ordinary surface dirt. The cleaning bath can not be dispensed with, but cleaning troubles are much less troublesome. This is important on a production line.

The cyanide solution is not difficult to maintain, but should be checked frequently by chemical analysis if a good color of finish is desired. The zinc content and sodium cyanide content are the most important. The cyanide is destroyed in the solution and has to be replaced by fairly large additions of sodium cyanide. The zinc content increases rapidly when all zinc anodes are used. This is due to the chemical solution of zinc from the anodes by the sodium cyanide plus the taking of zinc into solution by the electric current in electro chemical equivalent quantity which makes a total of zinc dissolved more than 100% of the ampere hours equivalent. You might say that the anode efficiency is more than 100%. Further, the cathode efficiency varies from 60 to 85%. Thus the zinc content of the solution increases rapidly. The zinc content of the solution is actually controlled by putting in steel anodes to decrease the zinc anode surface.

The caustic soda content of the solution is hard to determine. Some caustic is necessary for good conductivity. An excess of it is to be avoided, especially after the solution becomes contaminated with iron, as it will in time, especially with steel anodes.

The soda ash content is mostly due to the destruction of the cyanide in the solution. It and ammonia are apparently the chief products of decomposition of sodium cyanide. A lesser quantity probably comes from absorption of carbon dioxide from the air. Large amounts of soda ash apparently do no harm to the zinc deposit, but they do make working conditions bad, because the spray from the surface of the solution caused by evolution of hydrogen becomes heavily laden with it and quickly dries to a

disagreeable dust. Much of the soda ash can be removed by treatment with hydrated lime, or a large portion of it can be crystallized out by pumping the solution into an outdoor tank in cold weather and allowing it to become very cold. Then the crystals of soda ash will collect at the bottom and the upper liquid can be returned to the plating tank.

The best grade of zinc should be used for anodes, and they should have iron or steel hooks. When operating properly, the anodes will have a black film which is easily rubbed off and which dissolves as soon as the electric current ceases to flow. This is obtained with an anode current density of 10 to 15 amperes per square foot. Two to two and a half per cent of mercury in the anodes will usually furnish enough mercury to the solution to give a whiter deposit than can be obtained without the use of mercury. Trouble at times will be encountered with spots of mercury and dark or bluish deposits. This is usually in the morning when starting up. A relatively large amount of sodium cyanide helps to reduce this, but the only relief is a large addition of mercuric cyanide to the plating bath. The cyanide is made by dissolving mercuric oxide in sodium cyanide solution.

The conductivity of cyanide solutions is higher than that of sulphate solutions and it is easier to use higher current densities. We have used regularly approximately 40 amperes per square foot cathode current density. It has been claimed that high current densities cause rapid decomposition of sodium cyanide. Possibly we have suffered, but we have gained by speeding production. 122° F. is given as the maximum temperature for economical operation of the cyanide plating bath on account of the rapid decomposition of cyanide at temperatures above this. We prefer to operate around 100° F. to 110° F. principally because the fumes are less severe.

Barrel plating with cyanide has two difficulties. One is the short life of barrels in this solution as compared to the life of barrels in sulphate solution. However, there may be someone in the audience who has later information regarding material for cyanide plating barrels. A number of materials have been tried; micarta is said to be unsatisfactory. Transite board, an asbestos composition, has been suggested and so has rubber covered steel Wood will last only a week at best with continuous use. The other difficulty is dark colored work, and is only brightened by pouring a quantity of mercuric cyanide over the work in the

barrel about five minutes before removing from the plating tank. Mercury in the anodes for barrel plating is worthless. The great advantage of barrel plating with cyanide is due to the greater speed. On account of the much better conductivity of the solution and the denser zinc deposit, a protection equivalent to 48 hours in salt spray can be obtained in approximately half the time required in a sulphate bath.

Cast iron and malleable iron are difficult to galvanize with the cyanide bath. The sulphate is much more satisfactory for these two metals. Some lots of steel are difficult to barrel plate with cyanide after pickling in sulphuric acid. Steels with high sulphur and phosphorus content appear to be the one which give this trouble. By pickling with muriatic acid, the trouble is usually eliminated.

A cyanide plating solution of the following composition gives good results and can be used with or without mercury:

Sodium cyanide	7	oz. per gallon
Zinc oxide	3½	oz. per gallon
Mercuric oxide	1/20	oz. per gallon

or approximately the same composition can be obtained by using:

Sodium cyanide	4	oz. per gallon
Zinc cyanide	5	oz. per gallon
Caustic soda	3½	oz. per gallon
Mercuric oxide	1/20	oz. per gallon

We might summarize the two galvanizing methods by comparing their favorable and unfavorable characteristics.

For sulphate plating, the favorable ones are:

Ease of control.
Low cost of chemicals.
Good color of finish.

High cathode efficiency and, consequently, no hydrogen evolution t ogive disabreable spray; also has tendency for the zinc content of the slution to build up.

Some unfavorable characteristics are:

Poor throwing power and consequently thin deposits in the recesses of irregular or curved surfaces.

The work must be carefully cleaned and brushed, unless first given a cyanide zinc surface.

A. E. S. PAGE

Assembled Expert Scraps With and Without Significance

Why is it that almost everybody at a symphony concert looks a little sick.

* * *

The weather may be awful but it's better than none.

* * *

A husband is what is left of a bridegroom after the nerve has been removed.

* * *

The most difficult thing to deal with is an old deck of cards.

* * *

Don't ever present your wife to another man — he probably has one.

* * *

Too Busy

An Italian, having applied for American citizenship was being examined in the naturalization court.

"Who is President of the United States?"

"Mr. Hoover."

Who is Vice-President?"

"Mr. Curtis."

"Could you be President?"

"No."

"Why?"

"Mister, you 'scuse me, please; I vera busy worka da mine."

—*D. Nicosio.*

* * *

Sign in front of a tailor shop—"If your clothes don't fit you, we make them."

Women rest their chins on their hands when they're thinking to keep their mouths shut so they won't disturb themselves.

* * *

Every time a woman plans an out of town trip she runs downtown and buys out a department store.

* * *

The Tipster

The caller (A young man) —"So Miss Ethel is your oldest sister; who comes after her?"

Small Boy—"Nobody ain't come yet; but pa says the first fellow that comes can have her."

—*William Young.*

* * *

Bad Acting

Magician (to small boy he has called on stage)—"Now, my boy, you have never seen me before, have you?"

Little Boy—"No, Daddy."

* * *

Aviation Note

We will believe that aviation has really arrived when we see a two passenger airplane go by with seven or eight high school students seated in it.

* * *

Another thing this country needs is a spot remover to remove spots left by spot removers.

Dirt and sludge from surface of anodes may give rough work.

For cyanide zinc plating, some of the favorable characteristics are:

Excellent throwing power.
Clean anodes.
More dense deposit than with sulphate.
Shorter plating time.
Troubles due to incomplete cleaning are usually negligible.

The unfavorable characteristics are:

Color of finish is apt to be variable unless checked up frequently.

Spray from the solution due to evolution of hydrogren is disagreeable to workers.

Considerable sodium cyanide is destroyed and has to be replace.

Zinc content of solution increases very rapidly unless controlled by unsoluble anodes.

For production line work, the cyanide plating bath is much to be preferred.

"Principles of Electroplating and Electroforming" by Blum & Hogaboom is my chief reference book, and many of the ideas in this paper originally came from there.

ROSCOE W. RICE,
Hayes Wheels & Forgings, Ltd., Chatham, Ontario.

ELECTRODEPOSITION OF NON-METALLIC MATERIALS

Milford H. Corbin

At first sight, non-metallic materials would not appear promising for electro chemical processes because of their high insulating properties. Therefore, I would like to preface the actual subject by a brief comparison of the properties of the electrically charged particles well known to you as ions, as against the properties of electrically charged organic suspensions.

In the first case, these ions are vehicles by which the current is transported through the solution and undergo either an oxidation or reduction. For example, in the case of a copper sulphate solution (during electrolysis) the copper ion transports the positive current to the cathode, where it is reduced to the metallic form. This electrolytic process and its resulting effects is thoroughly familiar to you. On the

other hand, in the case of non-metallic materials, we have solids or small globules of liquid suspended in a liquid known as the external phase.

To give you a specific example, let us take castor oil, which you are all familiar with, and mix it with water. After shaking this mixture (illustration) we find small globules of the oil suspended in the water, but on standing a few moments, the oil and water separate into their respective layers. Now if a soap or similar material is added, these globules will remain in suspension for a long time, because each globule has become coated with a fine layer of emulsifying agent, or "protective colloid" (illustration). The important point which we wish to bring out at this stage is the fact that these very fine globules of oil which are suspended in the external phase (in this case pure water) possess like charges. Hence when the particles or globules tend to coalesce or run together, the like charges cause them to repel each other, thus keeping them in constant vibration. This is known as the Brownian movement. When an opposite charged particle is put in their midst, they are attracted and defloculate or come out of suspension. Therefore, when two electrodes are placed into a suspension or an emulsion of this kind, the suspended charged particles are attracted to the oppositely charged electrode, and this migration of these suspended particles is termed "electrophoresis." Therefore, you see that the distinction between electrolysis on the one hand, and electrophoresis on the other, depends on whether a solution or suspension is involved. You see then that if we can take a finishing or coating material, such as rubber, asphaltum, lacquer, or an analagous material, and permanently suspend them in water as the external phase, these suspended particles will naturally assume an electrical charge, and it will be possible to deposit the suspended material on an electrode if a current is passed through the suspension.

Probably the most highly developed process of depositing non-metallic materials in the anode process used for the electrodeposition of rubber. Latex is a natural emulsion of pure rubber in an aqueous external phase, and looks like fine milk, but is very much whiter in color, such as you see in this beaker. The rubber globule is about one micron or .00004 inches in diameter, and carries a negative charge. When the current has passed through the latex, pure rubber is deposited on the anode, as will be demonstrated later. Of course, commercially, it is necessary to have incorporated in the globule the required filter, accelerator, softener, etc., according to the specific requirements of the finally deposited rubber compound, so that when the deposited film is vulcanized or cured under the proper conditions, a finished product results. Since the mass of the suspended particles relative to their charge is large compared to the ion, it is therefore obvious that the current efficiency is exceptionally high. For example, 160 times as much rubber can be deposited by the same amount of current than nickel, giving a deposit 1400 times as thick as the nickel deposit. (Illustrates rubber deposition.) While this deposition is taking place, we wish to show you here a number of finished samples of electrodeposited rubber, illustrating the specific commercial applications. This process

was developed by Sheppard, Eberlin, and Beal, in the Eastman Kodak Research Laboratories. They found that about 30 to 50 volts and a current density of 1/10 to 1/3 ampere per square inch gives satisfactory deposits.

In this second beaker, we have an emulsion where asphaltum is dissolved in oil and suspended in water, and from this emulsion we will electrolytically deposit the asphaltum on the anode. (Illustrates electrodeposition of asphalt.) This, I understand, is also commercially applied in reclaiming asphaltum from residual oils, and used for japanning. In this process, the asphalt is plated out on the article which is used as the anode, and subsequently baked, giving a hard japan coating.

We also wish to show, in this third beaker that a nitrocellulose lacquer, complex in structure, can be uniformly suspended in water. Ordinarily, one would suppose water in contact with lacquer would cause a precipitation of the cotton, but by incorporating the proper protective colloid, we were able to hold them in suspension in their original form. The lacquer globules so suspended also carry a negative charge, and as a rsult, when the electric current is passed through the emulsion, electrophoresis takes place, and the lacquer particles deposit in a continuous film at the anode. (Illustration of electrodeposition of lacquer.)

This is a purely theoretical application, and is in a very much primitive stage. The electrodeposited film, although continuous in nature, does not possess the necessary properties at this state of development to have any immediate commercial application. However, it shows some of the remote possibilities awaiting the electroplater that in the future he will not only be called to deposit inorganic or metal coatings, but will be asked to deposit organic materials similar to what has been shown, including such things as dyeing, painting and coating metals and non-metals.

We wish to express our appreciation to the Goodrish Tire & Rubber Co. for the use of the samples of the electrodeposited rubber.

CHAIRMAN FEELEY: Are there any questions?

QUESTION: What kind of anode are you using there?

MR. CORBIN: In this particular case I have used zinc metal because the voltage I have been using is very crude, that is, the 45-volt radio "B" battery. If I had used brass, all these films would be tinted with a green color, where the acid of the bath has been decomposed and formed copper nitrate, as it were. In some cases, particularly in lacquers, and aluminum has its difficulties, you know, in deposition of materials, and so the next best bet was to use zinc metal. But in regard to electrodes, if anyone is interested in reading the facts of what electrodes are good in these cases, I have that complete data, not here, but in my room, if anybody is interested in it, and I will give you that if you want it.

MR. JERRY DE GRAZZIO: Lamp guards are made out of Bessemer wire. Could they be rubber plated?

PROVIDENCE-ATTLEBORO BRANCH

Meeting October 3, 1929

After roll call and reading and approval of minutes of previous meeting, Presidence Chace introduced Mr. Geo. Lawrence of the J. B. Ford Co. as the speaker of the evening.

Mr. Lawrence entertained us for nearly an hour, relating from his travels around the country on business trips.

A rising vote of thanks was extended Mr. Lawrence.

The question period was started by John Garrick on how to get an immersion copper on pieces of nickel tubing that will stand drawing through a draw plate. John said that some white substance was added to a pickle solution before the work was immersed.

There was quite a little discussion on the question, but it was not satisfactorily answered.

There were 10 present.

Adjourned 10:45 o'clock.

Meeting October 17, 1929

The minutes of previous meeting were read and approved. A letter from Supreme President H. H. Smith requesting the branch to co-operate by appointing a man to serve with the research committee. Mr. Ernest Alafeld was appointed.

Mr. Wm. Cahill was next called and he delivered a talk on "Preparation of Metals for Cleaning." This paper has been mailed to the editor and should appear in the Review.

A rising vote of thanks was extended Mr. Cahill for his comprehensive presentation of the subject.

There were eight members and one visitor present.

Adjourned about 10:30.

Meeting November 7, 1929

The meeting was called to order by President Chace and business was omitted to allow the speaker plenty of time.

Mr. R. J. O'Connor was introduced and he announced that his topic would be "The Relation of the Bureau of Standards to the Plating Industry."

Mr. O'Connor reviewed the work of the Bureau in solving some of the problems for the manufacturers; also how the contributions were secured to insure that the work will continue; also that there were two men, representing the society, working with Dr. Blum all the time. He stated that as the manufacturers had contributed the larger part of the funds, they naturally would expect consideration, and that was the reason why "spotting out" was taken up first.

Mr. O'Connor is Chairman of the Research Committee of the society.

After his talk, Mr. O'Connor said that he would be pleased to answer questions, and Dr. Strachan led by asking what was the method of approaching the manufacturers? Do they ask for immediate results?

Mr. O'Connor—We have to explain to them that we cannot give them an immediate answer as sometimes it takes a long time to find an answer.

Several ideas of appeal were suggested.

Questions:

Garrick—How can he hold a uniform color in plating brass on antimonial lead?

Dr. Strachan said that some metal from the pieces may dissolve in the bath, thereby affecting the color. Suggested first striking the articles in a copper bath.

Mr. O'Connor stated that at his shop they first copper plated the articles, then brushed them and then gave them one-half hour brass.

We feel that this work carried on by the research committee, co-operating with the Bureau, should have the support of all the branches as far as possible.

Mr. O'Connor was extended a vote of thanks and we hope he will come again.

We were glad to see John Oberanda, the first time in several years. There were 22 presnt.

Meeting November 21, 1929

The meeting was called to order by the President, Mr. Chace.

After the reading and approval of the minutes of previous meetings, a discussion was started on the topic, "For the Good of the Branch," with Dr. Strachan leading the talk.

The doctor reviewed some of the conditions as affecting the Foreman electroplate, tending to indicate the necessity for the foreman to master the most important essentials relative to analysis and control of solutions if he is to hold his job in the future.

Adjourned 10:30 o'clock.

Seven members present.

Meeting December 5, 1929

The president and vice-president were absent. The meeting was opened by the secretary and a letter from Harry Simmons was read calling for information on how to finish optical goods.

As there were not any members present who had experience on this line of goods, it was left for the secretary to get in touch with one who has.

Eight members present.

Adjourned 11 o'clock.

Meeting December 20, 1929

As there were but four members present, due no doubt to the very

disagreeable weather, the talk was led by Dr. Strachan on what we should do to increase interest in the meetings.

It was urged that we plan a program and then make an effort to carry it out.

Adjourned 10:30 o'clock. JOHN ANDREWS, Secretary.

NEWARK BRANCH

The regular open monthly meeting of the Newark Branch.

Applications were received from Mr. Sherji Furinchi of Ashka, Japan; Mr. Henry Wermerman of Newark; Mr. Charles J. Copley of Neitley.

Mr. Smith reported that he found a family with seven children and after buying shoes, rubbers and stockings and gloves and wish that next year Newark Branch would spend more money at Christmas to make some poor kiddies happy.

The speaker of the evening was Mr. Edward Homan who gave a very interesting talk on Lacquers, their manufacture, application, and their constituents of different kinds of lacquer and its uses.

Mr. Homan spoke on the constituents of lacquers and the different percent of ingredients used depending on the kind of metal and its wearing qualities depended upon it. Many questions were asked Mr. Homan and a very good discussion was had both pro and con.

Question: What is a good black on gold for relief?

Answer: Black Japan applied and rub off with hand.

Question: What is a good nickle solution for plating before chromium?

Answer: 8 oz. double salts, 4 single salts, 2 ammonium chloride, 2 oz. boric acid.

Question: Do you clean nickle plated work before chromium plating?

Answer: Wipe off with clean rag and immerse in chromium solution.

Question: What is the composition of sediment in bottom of chromium tank?

Answer: No answer.

Question: What is good dip on German silver to produce a satin finish?

Answer: Matt dip, composed of ½ gal. of nitric acid, ½ gal. of sulphuric acid, 4 oz. of zinc oxide. Solution heated to 180° and used at the temperature. More sulphuric finer grain matt. More nitric coarse grain matt.

The next open meeting will be held January 17, at 41 Franklin street and the evening will be devoted to moving pictures. The story of brass and copper and the story of the storage battery, and a two-reel comedy with real refreshments served afterwards.

The open meeting in February will be Friday evening the 21st and will have for its speaker Mr. George Ahl, who will speak on silver deposition on glass and other subjects.

At our March open meeting we will have Prof. Mandell of Pratt Institute, whose subject will be the plating of articles in alumium solutions.

GEORGE REUTER.

CHICAGO BRANCH

Regular monthly meeting of Chicago Branch, A. E. S., was held Saturday, January 11, 1930, at the Atlantic Hotel.

Meeting was called to order with Vice-President J. J. Witte presiding. The attendance was rather small for Chicago Branch. This was probably due to the bad weather Chicago is having at this time.

After the regular order of business was transacted M. O. E. Servis, our Librarian, took charge and called upon Mr. Harold Faint our instructor, who took for his subject, the article by Prof F. C. Mathers, in the Review.

Questions written on slips of paper were passed out among the members, who read and commented on them. This method brought out some of the important parts of the subject that would otherwise have been overlooked.

The meeting was both entertaining and educational and I am sure we all benefited by it.

The following questions were found in the box:

Ques. No. 1—What causes work Cadimum plated in a still tank to take on a very dark blue deposit? When work rod is oscillated, deposit is very white.

Ans. No. 1—Low in cyanide was given as one reason, and not the proper current density as another.

Ques. No. 2—If the hydrometer shows 22° in the chromium bath, would an addition of proper amount of chromic and sulphuric acid increase the throwing power?

Ans. No. 2—It would not under ordinary conditions.

Ques. No. 3—What is the reason chromium plates cloudy and blue?

Ans. No. 3—Temperature too high or too low, or too much sulphates.

Ques. No. 4—A window sash made of zinc and spring copper and soldered. How can this be oxidized uniform color? No particular color but must be uniform.

Immersion process desired.

Ans. No. 4—No answer.

Ques. No. 5—We have a single salt solution consisting of single salt, 24 oz. per gal.; boric acid, 2½ oz. per gal.; chlorides, 2 oz. per gal.; ph.=5.8; temperature 90° F. The sol. plates dark. How can it be brightened?

Ans. No. 5—Add ammonium chloride or a very small amount (about 50 cc of a saturated sol. per 100 gal.) of cadmium chloride.

Ques. No. 6—What is the cause of nickel anodes being coated with

green shine? Nickel sol. is composed of single salt, chloride of nickel and carbonate of nickel. Anodes, 99 per cent; temperature, 110° F.

Ans. No. 6—Ph. too high; in other words, the sol. is too alkaline.

J. C. KRETSCHMER, Secretary.

TOLEDO BRANCH

I wish to say that Toledo branch is coming to life and have just had a get-together dinner at the Secor Hotel and have decided to equip a laboratory in the Toledo Medical Building at Madison and Michigan Avenue, Toledo, Ohio. We are also fitting up this room as our regular meeting room and will hold regular meetings at this address on the first Thursday in each month.

We have just taken in three new members and are figuring on six to eight more.

I am, as always, your friend, L. D. COPE, Secretary.

PHILADELPHIA BRANCH

Regular monthly meeting of Philadelphia Branch was held, January 3rd, at the University of Pennsylvania, with Vice-President Lunbeck presiding; with all officers present and a good attendance.

The sum of $50.00 was donated to the Research Committee.

Three applications were received and one applicant reinstated.

Mr. Alfred Douty, of the American Chemical Point Co., gave a very interesting talk on "Inhibitors and Pickle Control," which was appreciated as shown by the questions asked and in discussing the various formulas.

The "Question Box" will be the topic at the February meeting and look for a good attendance and interesting questions asked.

Mr. B. W. Mott presented a resolution which was unanimously adopted. Expressing the heartfelt sympathy to Mrs. Scott in her great bereavement; and directed that a copy of the resolution be sent to her, and that the resolution be spread upon the minutes.

Mr. Geo. Gehling was elected as editor of the Quaker City Reminder.

PHILIP UHL, Secretary and Treasurer.

LOS ANGELES BRANCH

The regular monthly meeting was held at the Y. M. C. A. Hall, Wednesday evening, December 11, 1929, President C. E. Thornton presiding.

Minutes of the previous meeting were read and approved, communications and bills read, approved, and bills paid.

Mr. Philip Sievering's letter, which contained a request for funds from the Research Committee, was read and the secretary was instructed to send a check for $50.00.

Three applications for membership were read and the board of managers are to act on them.

Five new members were elected to the Los Angeles Branch.

Beginning with the next meeting, January 8, the branch will meet at the Elite, 633 South Flower Street, Los Angeles, Calif.

After the regular order of business, the librarian, Mr. Russill, had Mr. P. A. Boeck of the Oaktite Products, Inc., give us our first explanation of chemical terms used in a plating shop. It was enjoyed by all those present.

Mr. Boeck is going to test our solutions in the near future and, surely, this will be very interesting. No member should miss this opportunity. So come out and help your branch keep the usual high attendance mark.

MARCUS D. RYNKOFS, Secretary-Treasurer.

NEW YORK BRANCH

The regular meeting of the New York Branch of the A. E. S. was held at the World building, New York City, January 10, and was called to order by President F. Haushalter at 8:30 o'clock.

There was a large attendance at this meeting, also a large delegation from Newark Branch. They all came to this meeting to hear Dr. Pan give a talk on Analysis of Nickel Solutions and demonstration of the same, after which he was given a rising vote of thanks.

Now, to members of all other branches, New York Branch is having their Twenty-first Annual Banquet on Saturday evening, February 15, 1930, at the Aldine Club, 200 Fifth Avenue, corner of 23rd Street, in New York City. We would like to see as many members as possible at the afternoon session. A hearty invitation is extended to all—and don't forget to bring the ladies.

Adjournment was called at 11:30 o'clock.

CHAS. HAUSHALTER, Recording Secretary.

BOSTON BRANCH

The regular monthly meeting of the Boston Branch of the American Electro-Platers' Society was held at the American House, Boston, on Friday, January 10.

The meeting was called to order at 8:15 p. m. by President Gale with twenty-five members present. Because of having two guest speakers, the usual business was dispensed with in order to have sufficient time.

Dr. E. K. Strachan of Brown University spoke on and gave a demonstration of simplified methods of chemical control. This talk was extremely interesting and should prove of very great value to the members.

Mr. W. F. Cahill of the J. B. Ford Company spoke on "The Cleaning of Metals." An outline of the kinds of cleaning to be done and the

methods of doing this gave a comprehensive view of cleaning and brought out some very interesting facts.

Thanks were extended to both speakers who came from some distance on a very cold night.

The meeting was adjourned at 10:30 p. m.

THOMAS JOHNSON, Secretary.

BRIDGEPORT BRANCH

Meeting opened at 8:00 o'clock with President George Wagstaff presiding. The roll call of officers were read; one officer was absent. The minutes of the last meeting was read and accepted. Our next open meeting will be held in New Haven, and Chairman McChamberlain has arranged a very interesting program. So, by the way, it looks as if there would be quite a gathering to go along and give our New Haven members a showing. It was voted on that the Society furnish the refreshments.

The Secretary has sent the Convention Report to the library, and Mr. Davis, the librarian, has sent a letter of thanks to the Society.

The Bridgeport Branch is getting ready to put over one of the biggest banquets that they have ever undertaken.

The Treasurer's report was accepted as read.

A motion was made and seconded that the meeting adjourn at 9:25

WM. EHRENCRONA, Secretary.

ROCHESTER BRANCH

Rochester held a very interesting meeting on December 15; one application was received. A letter was received from President Horace H. Smith that the invitation of Rochester was accepted by the Research Committee and Bureau of Standards to meet in our city this year. March 22 was set as the date of our meeting, and Banquet Committees were appointed by President Reama, and the wheels were put in motion to make this year's session and banquet the best ever held in Rochester. We extend to all interested persons an invitation to come to Rochester this year and attend our meeting and banquet. We know the work the committees are doing and can assure all they will not be sorry they made the trip. Again, we remind you, March 22, 1930, at Power's Hotel, Rochester, N. Y.

Meet us in Rochester! CHAS. GRIFFIN, Secretary.

LOS ANGELES BRANCH

The Los Angeles Branch of the A. E. S. held its regular monthly meeting at its new meeting place, The Elite Catering Company, 633 South Flower Street, Los Angeles, Calif., Wednesday evening at 6:30, forty-two members and four guests being present.

The meeting was called to order, with President C. E. Thornton presiding, and all officers present. Communications and bills were read and approved.

Mr. Geo. W. Kyle gave a brief outline of benefits derived from the regular attendance of meetings and the necessity of a Chemistry Class for this Branch.

A committee of five was appointed to make arrangements for our first banquet, which is to be held on February 22, 1930.

Mr. Lamaureux of the Chicago Branch, who is visiting with the Angels, will be an invaluable guest during his stay here. Mr. Lamaureux gave us a very interesting address.

Chas. A. Russill, librarian, took charge of the meeting, the following questions were in the red box:

Ques. 1.—What causes Acid Copper solution to plate rough like sandpaper? I plate for forty-five minutes.

Ans.—Make addition of Molasses 3 oz. to a gal., or 1 oz. to a gal. of dextrine.

Ques. 2.—If the Nickel PH is correct and the metal content correct, and your nickel still pitts and is brittle, what shall I do?

Ans.—Use one-eighth oz. of sodium perborate per gallon.

Ques. 3.—What is meant by PH of solution?

Ans.—This question was explained on the blackboard by the Librarian.

Ques. 4.—What is the best PH at which to keep a Nickel solution before chromium plating and why?

Ans.—PH at 6.0 to 6.2 cold and 6.2 to 6.3 hot. Nickel should be plated slow with 1½ to 2 volts, giving a soft deposit.

Ques. 5.—What is a satisfactory combination Cleaner?

Ans.—Use Electric Cleaner at temperature of 180 to 200 degrees. Strike two seconds in the following solution:

1 oz. Soda Ash
1 oz. tri Sodium Phosphate
1 oz. Caustic Soda
1 oz. Copper Cyanide
1½ oz. Sodium Cyanide

Ques. 6.—What is the most practical pickling solution for a good sized job shop?

Ans.—Muriatic for sheet metal and Hydrophluric for sand castings.

Ques. 7.—What will be the results with a continual use of steel Annodes in Chromium solution?

Ans.—Nothing serious.

Ques. 8.—If a brass or bronze solution shows a crystalline or granular deposit, what should be done?

Ans.—Throw out and make new solution.

Ques. 9.—In plating a piece of nickelplated brass in Chromium, if

the nickel is cut through to the brass, that portion of the exposed brass will not take Chromium while the nickel will; why is this and how can it be overcome?

Ans.—If your Chromium solution is properly balanced with Chromic Acid and Sulphate, this will not occur.

The meeting was duly adjourned at 10:45 p. m.

M. D. RYNKOFS, Secretary.

CLEVELAND BRANCH

Our January meeting was the largest meeting this branch has ever had, there being twenty-eight members present out of a total of forty-two.

The Entertainment Committee reported everything in readiness for our Smoker, January 18, and mentioned among other things that they are going to have a good magician and good boxing, dancing girls, and refreshments, and they are going to see that everyone enjoys themselves.

Mr. E. S. Thompson then gave a demonstration of his Chloride Test, which was well received and was verified by one of our members who said it was quite as accurate as Mr. Thompson claimed, and in connection with 99% Depolarized anodes, was a very necessary test. This also lead to the question as to whether Nickel precipitated with Dimethylghoxime could be settled so as to take a quantitative measure of Nickel content, and one of our members said he was going to make some experiments, as he thought that probably the precipitate could be put in some light liquid so as to settle out in a certain time.

Mr. Mullinaux gave his experience with the new rapid copper solution as suggested by the Bureau of Standards and said he could plate so fast now that he had to slow up to let the men catch up with the work of getting things in the tank, as he said it was done so soon now that the whole cycle had to be rearranged.

H. J. TERDOEST, Secretary.

MILWAUKEE BRANCH

At the last meeting of the Milwaukee Branch A. E. S. a committee was appointed to make arrangements for our annual banquet and educational session. Robert Stenernagel was appointed chairman of the committee, the following were appointed to assist him: Henry Hurtig, hotel; Jack Geisman, entertainment; Frank Marx, secretary-treasurer; Henry Binder, educational program; Joe Bykowski, reception; Art Koehler, Mc. Di Cesare, E. Jaeger and Dan Wittig will be part of the general committee.

The Schroeder Hotel has been selected for Saturday, April 26. The program and features will be announced at a later day.

DAN. WITTIG.

APPLICATIONS

	Branch
B. Smith	St. Louis
Chas. C. Duvall, Evansville, Ind	St. Louis
A. G. Sindler, Evansville, Ind	St. Louis
Ralph R. Wilde, 137 W. 15th St., Los Angeles, Calif	Los Angeles
W. H. Whitman, 3429 Pasadena Ave., Los Angeles, Calif	Los Angeles
Thos. J. O'Connor, 2629 Beady St., Philadelphia, Pa	Philadephia
E. W. Fosberg, 336 Greenwood Rd., Sharon Hill, Pa	Philadelphia
Wm. Williams, Camden, N. J	Philadelphia
Shuji Turnichi, Osaka, Japan	Newark
Hy. Wermurman	Newark
Charles Copley	Newark
A. Slater, 906 Nelson Ave., Chicago, Ill	Chicago
Wm. Glomski, 2427 Coyle Ave., Chicago, Ill	Chicago
J. Knowdel, 19 Tower Hill Ave., Red Bank, N. J	New York
F. H. Beam, Matawan, N. J	New York

ELECTIONS

	Branch
Carl F. Weber, 505 First St., Ontario, Calif	Los Angeles
Fred D. Hyde, 142 E. 63rd St., Los Angeles, Calif	Los Angeles
Edgar H. Pangborn, 214 N. Curtis, Alhambra, Claif	Los Angeles
Henry Marne, 1906 W. 41st Pl., Los Angeles, Calif	Los Angeles
Robert W. Shill, 322 Harwood, Santa Ana, Calif	Los Angeles
R. Willis Zime, 4543 Springwells Ave., Detroit, Mich	Dertoit
E. J. Beverly, 912 Cherry St., Utica, N. Y	Rochester
H. Sanford, 437 Plymouth Dr., Syracuse, N. Y	Rochester
M. A. McDonald, 153 Willow Ave., Sherrill, N. Y	Rochester
Frank B. Lyman, 319 Arlington Ave., Syracuse, N. Y	Rochester
George Quinn, R. F. D. No. 1, N. Syracuse, N. Y	Rochester
E. W. Griesl, 5019 Parker Ave., Chicago, Ill	Chicago
H. H. Greeder, 5319 Montrose Ave., Chicago, Ill	Chicago
B. Keller, 1248 Diversey Pkwy., Chicago, Ill	Chicago

REINSTATEMENTS

	Branch
Robert C. Ledig, 114 W. Mt. Pleasant Ave., Mount Airy, Philadelphia, Pa.	Philadelphia

RESIGNED

	Branch
M. Robinson, 392 Brock Ave., Toronto, Canada	Toronto

TRANSFERS

	Branch
Louis Schulte, from Pittburgh to	Cleveland
Geo. Christenson, from Chicago to	Los Angeles

SUSPENSIONS

	Branch
D. A. Metz, Philadelphia, Pa	Philadelphia
F. Collins, Baltimore, Md	Philadelphia
J. Deutcher	Grand Rapids
John Balcer	Grand Rapids

BALTIMORE-WASHINGTON

Meets in Enoch Pratt Library, Calhoun and Hollins Sts. Geo. F. Turner, Secretary, 5324 Maple Ave., Pimlico, Baltimore, Md.

BOSTON

Meets at American House, Boston, Mass. First Thursday each month. Secretary Thos. Johnson, 41 first St., South Boston, Mass.

BRIDGEPORT

Meets first and third Friday of each month at Chamber of Commerce Rooms, Stratfield Hotel. Secretary. Wm. Ehrencrona, Box 301, R. F. D. No. 1., Bridgeport, Conn.

CHICAGO

Meets second Saturday of each month, at 8 p. m., Atlantic Hotel, 316 S. Clark St. Secretary, J. C. Kretschmer, 1914 Warner Ave.

CINCINNATI

Meets every Thursday, 7:30 p. m., at Vocational Training School, Spring and Liberty St. Secretary, Al. Yeager, 2021 Sherman Ave., Norwood, Ohio.

CLEVELAND

Meets first Saturday of each month at Hotel Winton. H. Terdoest, 180 Pioneer Ave., Akron, Ohio.

HARTFORD-CONN. VALLEY

Meets fourth Monday in each month alternately at 266 Pearl St., Hartford, Conn., and corner Broadway and Worthington St., Springfield. Secretary, Vernon Grant, 43 Putnam St., Bristol, Conn.

DAYTON

Meets first Saturday of each month at the Y. M. C. A., Dayton, Ohio. Secretary, Robert G. Suman, 2734 Ridge Road, Dayton, Ohio.

DETROIT

Meets the first Friday of each month at the Hotel Statler, Louis II Room, Detroit. Secretary, Chas. Phillips, 13421 Camden Ave., Detroit, Mich.

GRAND RAPIDS

Meets on the second Friday of each month at 528 Lake Michigan Drive, N. W. Secretary, Jacob Van Dyke, 1361 Union Ave. N. E., Grand Rapids, Mich.

INDIANAPOLIS

Meets the second Saturday of each month at Hotel [illegible] Secretary, Louis Mertz, 1725 Union St., Indianapolis, Ind.

LOS ANGELES

Meets second Wednesday of each month at the Elite, 633 E. Flower St., Los Angeles, Calif. Secretary, M. D. Rynkofs, 1354 W. 25th St., Los Angeles, Calif.

MILWAUKEE

Meets second and fourth Thursdays of each month at [illegible] St. & Highland Ave. J. N. Hock, 1229 W. 24th St., Milwaukee, Wis.

MONTREAL

Meets last Friday of month at Office of Secretary, John H. Feelay, 411 Aylmer St., Montreal, Quebec, Canada.

NEWARK

Meets first and third Fridays of each month at Franklin Hall, 41 Franklin St., Newark, N. J., at 8 p. m. Secretary-Treasurer, Geo. Rueter, P. O. Box 201, Newark, N. J.

NEW YORK

Meets every second and fourth Fridays of each month [illegible] World Building, Park Row, New York City, N. Y. Secretary Treasurer, J. E. Stoehr, 2581 46th St., Astoria, L. I.

PHILADELPHIA

[illegible] first Friday of each month in the Harrison Laboratory Building, University of Pennsylvania, 34th and Spruce Sts. Secretary, P. Uhl, 2432 North 29th St., Philadelphia, Pa.

PITTSBURGH

Meets first Friday of each month at 8 p. m., at downtown branch, Y. M. C. A. Secretary, S. E. Hedden, 227 Fifth St., Aspinwall, Pa.

PROVIDENCE-ATTLEBORO

Meets first and third Thursday of each month at 44 Washington St., Prov. Engineers Rooms, Providence, R. I. Secretary, J. H. Andrews, 19 Rosedale St., Providence, R. I.

ROCHESTER

Meets every third Friday of each month at the Powers Hotel. Secretary, Chas. Griffin, 24 Garson Ave., Rochester, N. Y.

ST. LOUIS

Meets second Friday of each month at Central Y. M. C. A., 16th and Locust St. Secretary, C. T. McGinley, 8214 Fairham Ave., University City, Mo.

TOLEDO

Meets first Thursday of each month at Toledo Secor Hotel, corner Cherry and Page Sts. Secretary, L. D. Cope, 3747 Grantley Rd., Toledo, O.

TORONTO

Meets fourth Monday of each month at Canadian Foresters' Hall, 22 College St., Room No. 2. Secretary, H. W. Graham, 102 Robina Ave., Toronto, Canada.

WATERBURY

Meets every second and fourth Thursday of each month. Secretary, Wm. F. Guilfoile, Garden Theatre Bldg., East Main St., Waterbury, Conn.

WORCESTER

Meets Directors' Room, Chamber of Commerce, Worcester, Mass. Roger H. Bryant, Secretary, 94 Grove St., Worcester, Mass.